We claim:

1. A method of immobilizing membrane-associated molecules in silica matrixes comprising combining a liposome-assembly comprising the membrane-associated molecule with a protein- and membrane-compatible sol-gel precursor under conditions which allow a gel to form.

2. The method according to claim 1, wherein the protein- and membrane-compatible sol-gel precursor is selected from an organic polyol silane and sodium silicate.

3. The method according to claim 2, wherein the organic-polyol silane precursor is derived from sugar alcohols, sugar acids, saccharides, oligosaccharides or polysaccharides.

4. The method according to claim 3, wherein the organic-polyol silane precursor is derived from glycerol, sorbitol, maltose or dextran.

5. The method according to claim 4, wherein the organic-polyol silane precursor is selected from diglycerylsilane (DGS), monosorbitylsilane (MSS), monomaltosylsilane (MMS), dimaltosylsilane (DMS) and a dextran-based silane (DS).

6. The method according to claim 5, wherein the organic-polyol silane precursor is diglycerylsilane (DGS).

7. The method according to claim 1, wherein the membrane-associated molecule is selected from non-natural ionophores, ion channel proteins, ion-channel receptors, G-protein coupled receptors, membrane transport proteins or membrane associated enzymes.

8. The method according to claim 6, wherein the membrane-associated molecule is selected from gramicidin, bacteriorhodopsin, the acetylcholine receptor and ionomycin.

9. The method according to claim 1, wherein the liposome comprises phospholipids.

10. The method according to claim 9, wherein the lipid comprises 1,2-dioleoyl-*sn*-glycero-3-phosphocholine (DOPC).

11. The method according to claim 1, comprising the steps of :

(i) combining an aqueous solution of the protein and membrane-compatible, sol gel precursor with an aqueous solution of a liposome assembly comprising the membrane-associated molecule;

(ii) adjusting the pH of the combination of (i) so that it is in the range of about 4-11.5;

(iii) shaping the combination into a desired shape;

(iv) allowing the combination to gel; and

(v) aging and partially drying the gel.

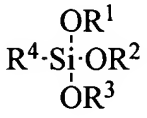
12. The method according to claim 11, wherein the gel is dried in an aqueous buffer, optionally comprising an effective amount of a humectant.

13. The method according to claim 11, wherein the aqueous buffer comprises about 5% to about 50%% (v/v) of glycerol.

14. The method according to claim 1, wherein the liposome- assembly comprising the membrane-associated molecule and the protein and membrane-compatible, sol-gel precursor are combined in the presence of an indicator molecule and/or in the presence of one or more ligands for the membrane-associated molecule.

15. The method according to claim 1, further comprising combining the liposome assembly and sol-gel precursor in the presence one or more additives which causes spinodal decomposition (phase transition) before gelation.

16. The method according to claim 15, wherein the one or more additives is selected from one or more of water-soluble polymers and one or more compounds of Formula I:



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wherein wherein R^1, R^2 and R^3 are the same or different and represent a group that may be hydrolyzed under normal sol-gel conditions to provide Si-OH groups; and R^4 is group selected from polymer-(linker)$_n$- and  , where n is 0 or 1 ,

17. The method according to claim 16, wherein the one or more additives are selected from one of more water soluble polymers.

18. The method according to claim 17, wherein, the one or more water soluble polymers are selected from one or more of polyethylene oxide (PEO); polyethylene glycol (PEG); amino-terminated polyethylene glycol (PEG-NH_2); amino-terminated polyethylene oxide (PEO-NH_2); polypropylene glycol (PPG); polypropylene oxide (PPO); polyalcohols; polysaccharides; poly(vinyl pyridine); polyacids; polyacrylamides; and polyallylamine (PAM).

19. The method according to claim 18, wherein the one or more water soluble polymers are selected from one or more of PEO, PEO-NH_2, PEG, PPG-NH_2, polyNIPAM and PAM.

20. The method according to claim 19, wherein the one or more water soluble polymers are selected from one or more of PEO, PEO-NH_2 and polyNIPAM.

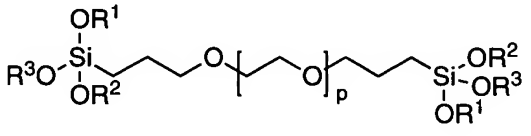
21. The method according to claim 20, wherein the water soluble polymer is PEO.

22. The method according to claim 21, wherein the PEO has a molecular weight between about 2000-100000 Da.

23. The method according to claim 22, wherein the PEO has a molecular weight of about 10000 Da.

24. The method according to claim 16, wherein the one or more additives are one or more compounds of Formula I.

25. The method according to claim 24, wherein the compounds of Formula I are selected from one or more of compounds of Formula 5:



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wherein p is an integer between about 4 and 227 and R^1-R^3 are the same or different and are selected from C_{1-4}alkyl.

26. A protein- and membrane-compatible sol-gel with a liposome-assembly immobilized therein prepared using the method according to claim 1.

27. A protein- and membrane-compatible sol-gel with a liposome-assembly immobilized therein prepared using the method according to claim 16.

28. A method for the detection of modulators of a membrane-associated molecule comprising:

(a) exposing the protein- and membrane-compatible sol-gel according to claim 26, to one or more test substances; and

(b) detecting a change in one or more characteristics of the membrane-associated molecule,

wherein a change in the one or more characteristics of the membrane-associated molecule in the presence of the one or more test substances compared to a control indicates that the one or more test substances are modulators of the membrane-associated molecule.

29. A method for the detection of modulators of a membrane-associated molecule comprising:

(a) exposing the protein- and membrane-compatible sol-gel according to claim 27, to one or more test substances; and

(b) detecting a change in one or more characteristics of the membrane-associated molecule,

wherein a change in the one or more characteristics of the membrane-associated molecule in the presence of the one or more test substances compared to a control indicates that the one or more test substances are modulators of the membrane-associated molecule.

30. The method according to claim 28, wherein the membrane-associated molecule is an ion channel molecule and the characteristic that is detected is ion flux through the molecule.

31. The method according to claim 29, wherein the membrane-associated molecule is an ion channel molecule and the characteristic that is detected is ion flux through the molecule.

32. The method according to claim 28, wherein the membrane associate molecule is a membrane receptor and the characteristic that is detected is binding of a ligand to the receptor.

33. The method according to claim 29, wherein the membrane associate molecule is a membrane receptor and the characteristic that is detected is binding of a ligand to the receptor.

34. The method according to claim 32, wherein the ligand is radiolabelled.

35. The method according to claim 33, wherein the ligand is radiolabelled.

36. The method according to claim 28, further comprising combining the liposome-assembly comprising the membrane-associated molecule and the protein and membrane-compatible, sol-gel precursor in the presence of an indicator molecule and/or in the presence of one or more ligands for the membrane-associated molecule.

37. The method according to claim 29, further comprising combining the liposome-assembly comprising the membrane-associated molecule and the protein and membrane-compatible, sol-gel precursor in the presence of an indicator molecule and/or in the presence of one or more ligands for the membrane-associated molecule.

38. An improved method for the detection of membrane potentials in a sol-gel entrapped liposome assembly comprising a membrane associated molecule, wherein the membrane-associated molecule is an ion-channel molecule, comprising:

(a) obtaining a solution of the liposome assembly having an indicator molecule located on the interior of the assembly;
(b) removing the indicator molecule from solution external to the liposome assembly;
(c) combining the liposome assembly solution with a silica precursor solution under conditions which allow a gel to form;
(d) contacting the gel with the ion and optionally a test substance; and
(e) detecting a change in the indicator molecule upon transmembrane flux.

39. The method according to claim 38, wherein the indicator molecule interacts with the surface of the sol-gel.

40. The method according to claim 39, wherein the indicator molecule is safranine O.

41. The method according to claim 38, wherein the indicator molecule acts by detecting the ion directly upon entry into the interior of an entrapped liposome.

42. The method according to claim 41, wherein the indicator molecule is a Ca(II) dependent fluorophore.

43. The method according to claim 42, wherein the indicator molecule is fluo-3.

44. The method according to claim 43, where the response of fluo-3 is modulated by agonist or antagonist binding to a ligand-controlled ion gated (LCIG) receptor embedded in the lipid membrane.

45. The method according to claim 44, where the LCIG receptor is nicotine acetylcholine receptor (nAChR).

46. A kit, biosensor, microarray, chromatographic or bioaffinity column comprising the protein- and membrane-compatible sol-gel with a liposome-assembly immobilized therein according to claim 26.

47. A kit, biosensor, microarray, chromatographic or bioaffinity column comprising the protein- and membrane-compatible sol-gel with a liposome-assembly immobilized therein according to claim 27.

48. A method of conducting a target discovery business comprising:

(a) providing one or more assay systems for identifying test substances by their ability to modulate one or more membrane-associated molecules based systems, said assay systems using a method according to claim 28;

(b) (optionally) conducting therapeutic profiling of the test substances identified in step (a) for efficacy and toxicity in animals; and

(c) licensing, to a third party, the rights for further drug development and/or sales or test substances identified in step (a), or analogs thereof.

49. A method of conducting a target discovery business comprising:

(a) providing one or more assay systems for identifying test substances by their ability to modulate one or more membrane-associated molecules based systems, said assay systems using a method according to claim 29;

(b) (optionally) conducting therapeutic profiling of the test substances identified in step (a) for efficacy and toxicity in animals; and

(c) licensing, to a third party, the rights for further drug development and/or sales or test substances identified in step (a), or analogs thereof.